

Status of GRETINA

I.Y. Lee, R.M. Clark, M. Cromaz, M.A. Deleplanque, M. Descovich, P.Fallon, A.O. Macchiavelli, F.S. Stephens, D.Ward

Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720

Gamma-ray energy tracking is a new concept for the detection of gamma radiation. With a gamma ray energy-tracking array, the individual interactions of all the gamma rays are identified by their energies and positions. Then, using tracking algorithms based on the properties of gamma ray interactions, the scattering sequences are reconstructed. This will result in high peak efficiency, peak-to-background ratio, and position resolution. Research and development efforts have advanced the required technology in a number of crucial areas and the construction of such an array is now possible.

In June 2003 a proposal was submitted to DOE for funding an array which covers 1/4 of the total solid angle. This array is named GRETINA (Gamma Ray Energy Tracking In-Beam Nuclear Array), and is the first stage towards building the 4π array GRETA. Although it does not have the full efficiency of an array with 4π coverage, it does provide a number of new capabilities. Its better position resolution will make it a very powerful tool for high energy resolution experiments involving large recoil velocity, such as exotic nuclei produced in fragmentation reactions. These experiments will study the evolution of nuclear shell structure in very neutron-rich nuclei. The higher efficiency for high-energy gamma rays will open new opportunities in the study of giant resonances, such as the pygmy dipole resonance from the oscillations of outer layer of the neutrons. The compactness of the array will enable easy coupling with auxiliary devices, such as recoil separators and particle detectors. These combinations will provide improved sensitivity for experiments using weak radioactive beams and very low cross section reactions.

We received CD0 (mission need) approval in August. Following CD0 we completed the Conceptual Design Report and the Project Execution Plan, and submitted them for technical review. Two reviews were completed in 2003, a LBNL project vetting review in November and the DOE technical, cost, and management review in December. In February 2004, DOE gives the CD1 (preliminary baseline range) approval. The estimated cost of this equipment is \$17M. The construction of GRETINA started in 2004 and, according to current schedule, will be completed in 2010. The funding profile and schedule of critical decisions are shown in figure 1 and table 1, respectively.

The GRETINA R&D efforts have made several major achievements in this year. They are:

- Completed tests of the prototype signal digitizer module (DSP) and made design modifications required to instrument the GRETINA three crystal detector prototype. Twenty units were then produced.
- Developed a high-speed data acquisition system using the signal digitizer module. This VME-based system has a maximum data rate of 15 Mb/s.
- Developed and assembled software for data acquisition and analysis. This includes programs for control, readout, event building, calibration, and signal decomposition.
- Performed an in-beam test with the GRETA prototype II detector and the 8-channel DSP modules and demonstrated position resolution of better than 2.5 mm (RMS average in three dimensions).
- Studied the effect of impurity concentration and neutron damage on the pulse shape and the impact on the position resolution.

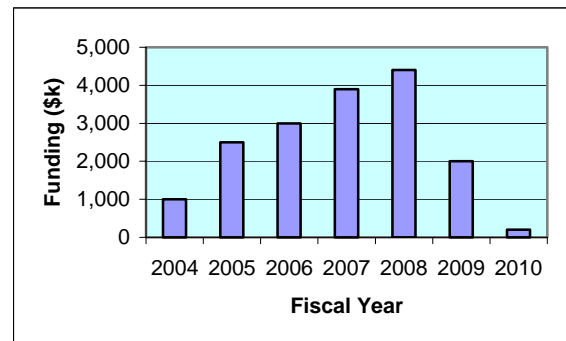


FIG. 1: Funding profile of GRETINA.

CD0 : Mission need	Aug. 2003
CD1 : Preliminary Baseline Range	Feb. 2004
CD2A/CD3A : Performance Baseline range for long lead time items	April 2005
CD2B/CD3B : Start Construction	Sept. 2007
CD4 : Start of Operation	May 2010

Table. 1. Schedule of critical decisions of GRETINA